



JULY 22, 2020

TESTIMONY BEFORE THE SENATE BANKING SUBCOMMITTEE ON ECONOMIC POLICY¹

Hearing on “U.S.-China: Winning the Economic Competition”

BY

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¹ In addition to new material, this testimony includes original content from the witness's previously published and forthcoming work, and media commentary.

I. Key Observations²

Chairman Cotton, Ranking Member Cortez Masto, distinguished members of the subcommittee, thank you for the opportunity to share insights on a topic of vital importance to the United States. I want to begin with five observations on the economic competition with China:

- 1) **U.S. economic security is entrenched in American technological leadership.** The 21st century will be defined by competition; a contest of economic power rooted in technological advances. How countries decide to compete will shape the lives of billions of people. Technology-leading countries will determine how to harness new technologies to combat disease, feed their people, counter climate change, gain wealth, explore the universe, gain influence over others, secure their interests, and protect their independence and freedom. The leaders in adopting emerging technologies such as artificial intelligence (AI), quantum sciences, biotechnology, and next-generation telecommunications, and those who shape their use, will garner economic, military, and political strength for decades.
- 2) **American technological leadership is at risk.** The United States of today is rooted in investments in education, science, research and development (R&D), and infrastructure made decades ago. On its current trajectory, with a shrinking share of global R&D spending, human capital shortfalls, and the rapid rise of a near-peer competitor, the United States cannot continue to coast. America's ability to harness the emerging technologies that will fuel the 21st century economy to the fullest extent possible is at stake. Falling short would squander economic and societal benefits and expose the United States to avoidable risks and challenges.
- 3) **The United States needs a national strategy for technology to effectively compete.** China has become a serious technological competitor. On strategic emerging technologies such as 5G wireless networks, AI, and genomics, China is at rough parity with the United States, and perhaps ahead. Much of China's success lies in its ability to formulate a comprehensive, long-term government strategy to gain dominance in key strategic technologies. In contrast, in the United States such policymaking is generally reactive and piecemeal: The United States needs a strategic, national level approach to effectively compete with China.
- 4) **Multinational collaboration should be a cornerstone of a national technology strategy.** The United States cannot go it alone. No one country can achieve its full potential in desired capabilities across the spectrum of critical technology areas on its own. Nor can any single state muster the resources to nurture all the necessary talent and control vital supply chains needed to achieve and maintain such technological leadership. Instead, America should maximize one of its greatest competitive strengths: its unmatched network of allies and partners. Broad-based, proactive, and long-term multilateral cooperation among like-minded countries is needed to maximize effectiveness across a range of areas, including R&D, supply chain diversity and security, standards-setting, multilateral export controls, and countering the illiberal use of technology.
- 5) **The pandemic crisis presents opportunity and urgency to act.** The global order is at an inflection point where decisions made by world leaders in coming months will shape the world for decades. The stakes are high: long-term economic and technological competitiveness, critical infrastructure integrity and security, and cohesion among the world's liberal democracies. Collaboration between the allies will help to ensure that the upheavals of the post-pandemic world can be dealt with more effectively. It will also improve the chances that the coming decades are ones where their societies and economies can prosper, all while blunting the coercive power of authoritarian countries.

² A portion of these observations are derived or pulled directly from a forthcoming report from the Center for a New American Security's Technology Alliance Project, which the witness leads, and from *The American AI Century: A Blueprint for Action*, for which the witness was the lead author.

II. Recommendations³

The U.S.-China tech relationship requires a recalibration. Congress and the administration can advance U.S. national security and competitiveness by undertaking major investments in the U.S. tech sector, establishing new rules for technology development and trade, and increasing collaboration with allies.

Promote American Innovation

- **Increase R&D spending.** The United States should increase total national R&D spending from 2.8 percent to 4 percent of gross domestic product (GDP) and federal R&D spending from 0.7 percent to 1.2 percent.
- **Increase science, technology, engineering, and math (STEM) education and training.** The U.S. government should invest in improved STEM education and professional development for teachers. Congress should incentivize private industry workforce training in STEM.
- **Attract foreign STEM talent.** Congress should raise the cap for H1-B visas and remove the cap for advanced-degree holders. Congress should also create new ways to recruit high-skilled immigrants to tackle acute talent shortages for STEM jobs.
- **Secure and diversify supply chains.** The United States should diversify and secure supplies for key technology inputs such as rare earth elements and semiconductors by investing in domestic industries and working with partners to build trusted international supply chains.

Protect Key Areas of Competitive Advantage

- **Establish multilateral export controls on semiconductor manufacturing equipment (SME).** The United States should protect its competitive advantage in hardware by establishing multilateral export controls on SME and design tools in partnership with key allies Japan, the Netherlands, and South Korea.
- **Establish end-use based export controls for China.** The U.S. Commerce Department should develop export control regulations for U.S.-origin and U.S.-developed products with end uses at odds with American security interests and values, such as human rights abuses or adversary military uses.
- **Ensure sufficient resources for counter-espionage investigations.** Congress should ensure the FBI and Department of Justice are sufficiently resourced to conduct counter-espionage investigations, particularly in Chinese language resources and scientific and technical expertise.
- **Develop better collaboration with universities.** The FBI should increase collaboration with universities to counter espionage threats. This should include reestablishing the National Security Higher Education Advisory Board or similar body.
- **Create a new sanctions authority to target Chinese firms that steal U.S. technology.** The Treasury Department, working with the Commerce and State Departments, should cut off from the U.S. financial system Chinese firms that engage in intellectual property (IP) theft.

Partner with Other Democratic Technology Leaders

- **Create a new international regime for technology policy.** The United States should lead the creation of a new international organization for technology policy comprised of democratic, technology-leading nations (a “technology alliance”). Multilateral cooperation is needed to maximize effectiveness in R&D, supply chain security, standards-setting, export controls, and countering illiberal uses of technology.

³ These recommendations are derived or pulled directly from *The China Challenge: Strategies for Recalibrating the U.S.-China Tech Relationship*, for which the witness was a co-author.

III. What Multinational Tech Policy Could Look Like

I provide two vignettes of strategic multinational technology policy opportunities. Today, technology policy coordination among the United States and its allies is largely ad-hoc, stove piped, and disjointed. The resulting decisions and actions often fail to take into account the broader strategic context, blunting the effectiveness of the policies designed to achieve a desired outcome and impairing the ability to effectively respond to second and third order consequences, be they anticipated or unforeseen. These inefficiencies are rooted in an underappreciation of how intricately linked the technology futures of the world's liberal democracies are. To illustrate what comprehensive multilateral technology policy collaboration could look like, I will focus on two technology areas of fundamental importance to the economic competition with China: 5G and semiconductors.

The Way Forward on 5G: Open Interfaces⁴

Communication networks are the central nervous system of the 21st century economy. The fifth generation of wireless—5G—will be essential to and inseparable from all we do. Getting 5G right is all the more urgent. Next generation 5G networks will enable telemedicine, self-driving cars, and a proliferation of Internet of Things devices to fuel the future digital economy. Secure, reliable 5G networks will be essential elements of national infrastructure. Chinese firms, Huawei most prominently, pose unacceptable risks to U.S. national security, and the security of America's allies and partners.

The United States has the opportunity to promote a sound alternative to 5G that could lead to a paradigm shift in the industry: wireless infrastructure built on a modular architecture with open interfaces. A modular architecture allows an operator to choose multiple vendors for a range of offerings, rather than being locked in with a single large integrated vendor. Open interfaces—the ability of equipment from any vendor to work with that of another—make that possible. Such a shift means upending the industry status quo that is dominated by four telecommunications equipment providers: China's Huawei, Finland's Nokia, Sweden's Ericsson, and South Korea's Samsung. Whereas other proposed responses to the Huawei dilemma and the problematic current state of competition in the telecommunications industry—such as creating a U.S. national champion or taking an equity stake in Nokia or Ericsson—fiddle at the margins, switching to an industry centered on open interfaces would change the game altogether.

A restructured industry based on open interfaces would directly address the prevailing concerns over untrusted vendors such as Huawei and the broader inefficiencies of the industry. There are distinct advantages to be gained in security and interoperability, supply chain resiliency, probable cost savings, and the opportunity to stimulate much-needed competition in the sector. Taken together, these advantages do much to blunt Beijing's industrial policies that have enabled Huawei's predatory anti-competitive practices.

The United States should work with allies and partners to promote the shift to telecommunication infrastructure based on open interfaces. Like the United States, these countries have a shared interest in building secure and resilient infrastructure. Operators in Asia, Europe, and North America are already deploying open architecture networks. The focus of these rollouts is on open interfaces for the radio access network (RAN), typically called 'open RAN'.

There are two key areas for multilateral cooperation:

One, encourage joint R&D and deployment of open RAN. Joining forces with telecommunications technology leaders Japan, South Korea, Finland, and Sweden will harness the knowledge of the world's telecommunications experts. It will also incentivize the relevant companies and governments to promote open architecture as a preferred alternative.

⁴ These recommendations are derived or pulled directly from the forthcoming report *Open Future: The Way Forward on 5G*, for which the witness is the lead author.

Two, promote multilateral 5G policies. The world's leading democracies working in concert have the purchasing power to ensure that an alternative to the 5G status quo is viable. Multilateral coordination will help tech-leading democracies regain the competitive edge in global telecommunications and be able to proliferate more secure and robust communications infrastructure to middle powers. Working in concert to help Ericsson, Nokia, and Samsung transition to a revamped industry based on open interfaces will help to cement critical support.

Preserving America's Edge in Semiconductors⁵

Semiconductors comprise foundational technology for the 21st century. This sophisticated hardware is essential for computing, communications, and critical infrastructure, and is a key enabler of fields such as robotics and AI. Semiconductors are the backbone of modern military and economic power. The United States has a major global lead in semiconductor design, a considerable technological strength which China looks to challenge through a concerted technology indigenization and innovation effort. To safeguard and preserve its advantage, the United States should pursue a three-part multinational strategy.

One, is to enact multilateral export controls in concert with allies and partners, to protect their collective competitive edge in hardware. China is currently heavily dependent on imports of foreign-manufactured semiconductors to meet internal demand. As part of its Made in China 2025 plan, China is looking to reduce its reliance on foreign chips by ramping up domestic semiconductor production.⁶ Yet this desire to indigenize production is a major source of strategic leverage for the United States.

To accomplish this goal, China needs foreign imports of semiconductor manufacturing equipment (SME), which are the equipment and tools needed to establish a chip fabrication facility, or foundry. The global SME market is highly centralized, with the United States, Japan, and the Netherlands accounting for 90 percent of global SME market share.⁷ In key areas the market is even more concentrated. A single Dutch company is the sole supplier of extreme ultraviolet lithography machines required to make the latest generation of semiconductors.⁸ Nearly the entire global supply of photoresists, chemicals essential to the production of semiconductors, is produced by a handful of companies based in the United States, Germany, Japan, and South Korea.⁹

The Commerce Department and State Department should work with key allies and partners (the Netherlands, Japan, South Korea, and Singapore) to establish multilateral export controls on SME, restricting sales to China. While export controls on semiconductors themselves should be rare and targeted, such as the action against Huawei and a handful of other companies linked to the Chinese military, the United States should enact broad restrictions on sales of SME to China, working in concert with allies and partners, in order to sustain the U.S. advantage in hardware.

Two, is to secure and diversify semiconductor supply chains by setting up new semiconductor manufacturing facilities known as 'fabs'. The United States should lead the creation of a semiconductor fab consortium, consisting of the like-minded countries that produce and consume much of the world's chipset output.

⁵ These recommendations are derived or pulled directly from *The American AI Century: A Blueprint for Action*, for which the witness was the lead author, from Martijn Rasser, "Countering China's Technonationalism," *The Diplomat*, April 24, 2020, <https://thediplomat.com/2020/04/countering-chinas-technonationalism/>, and from *Rising to the China Challenge: Renewing American Competitiveness in the Indo-Pacific*, for which the witness was a co-author.

⁶ "The Potential Impacts of the Made in China 2025 Roadmap on the Integrated Circuit Industries in the U.S., EU and Japan," working paper, U.S. International Trade Commission, August 2019, https://www.usitc.gov/publications/332/working_papers/id_19_061_china_integrated_circuits_technology_roadmap_final_080519_kim_verwey-508_compliant.pdf; Addition of Entities to the Entity List and Revision of an Entry on the Entity List, 84 Fed. Reg. 121 (June 24, 2019), <https://www.federalregister.gov/documents/2019/06/24/2019-13245/addition-of-entities-to-the-entity-list-and-revision-of-an-entry-on-the-entity-list>; Ana Swanson, Paul Mozur, and Steve Lohr, "U.S. Blacklists More Chinese Tech Companies Over National Security Concerns," *The New York Times*, June 21, 2019, <https://www.nytimes.com/2019/06/21/us/politics/us-china-trade-blacklist.html>; Ana Swanson and Paul Mozur, "U.S. Blacklists 28 Chinese Entities Over Abuses in Xinjiang," *The New York Times*, October 7, 2019, <https://www.nytimes.com/2019/10/07/us/politics/us-to-blacklist-28-chinese-entities-over-abuses-in-xinjiang.html>; and Department of Commerce, "Addition of Certain Entities to the Entity List," Richard Ashooh, 15 CFR Part 744, October 7, 2019, <https://s3.amazonaws.com/public-inspection.federalregister.gov/2019-22210.pdf>.

⁷ John VerWey, "What's Causing U.S. Semiconductor Equipment Production and Exports to Grow?" Usitc.gov, January 2019, https://www.usitc.gov/publications/332/executive_briefings/ebot_john_verwey_semi_manufacturing_equipment_pdf.pdf.

⁸ "The Health and Competitiveness of the U.S. Semiconductor Manufacturing Equipment Industry," working paper, U.S. International Trade Commission, July 2019, https://www.usitc.gov/publications/332/working_papers/id_058_the_health_and_competitiveness_of_the_sme_industry_final_070219checked.pdf.

⁹ "Photoresist," Science Direct, <https://www.sciencedirect.com/topics/engineering/photoresist>; and Kiran Pulidindi and Soumya Chakraborty, "Photoresist and Photoresist Ancillaries Market Size By Product," Global Market Insights, <https://www.gminsights.com/industry-analysis/photoresist-and-photoresist-ancillaries-market>.

These countries — such as the United States, Germany, France, South Korea, Japan, the United Kingdom, and the Netherlands — could collaborate to set up new fabs outside of China.

These countries have a common interest in moving semiconductor supply chains out of China and introducing greater geographic diversity in global semiconductor supply chains. Taiwan in particular plays an outsized role in the global semiconductor market and its proximity to China makes it vulnerable to espionage, sabotage, and blockades. The consortium could serve as a mechanism to cooperate with Taiwan on safeguarding its semiconductor industry against undue Chinese influence. One way to do this is building new production capacity elsewhere, such as the agreement the United States concluded with Taiwanese semiconductor firm TSMC. Consortium members can also help Taiwan with investment screening and building safeguards against Chinese attempts to siphon human capital.

Three, is to lay the foundation for the next generation of microelectronics. This entails doubling down on R&D. Breakthroughs in areas such as novel materials and microelectronics design will be necessary to continue effective transistor scaling—the process of increasing the number of transistors on a single chip—because researchers are approaching the physical limitations of silicon, the prevailing semiconductor material.

Mechanisms to promote multinational collaboration range from personnel exchanges to establishing cooperative international R&D centers at home and abroad. DARPA's Electronics Resurgence Initiative could serve as a model for what an expanded multinational effort could look like.¹⁰ Such collaborative relationships can be encouraged by enhancing visa and work permit regimes, providing grants and loans, and organizing multinational innovation prize competitions. Such competitions could be modeled on DARPA's series of Challenges and the XPRIZE competitions, which have successfully tackled some of the toughest science and engineering problems.¹¹

In closing, U.S. technological leadership is a core component of the economic competition with China. To maximize its potential in this competition, the United States should craft a national strategy for technology that has collaboration and cooperation with allies and partners as a key feature. Working in concert, the world's tech-leading liberal democracies can build and maintain a vibrant, innovative global economy, all while promoting and protecting democratic norms and principles and blunting Chinese mercantilist policies.

I look forward to your questions.

¹⁰ Defense Advanced Research Projects Agency, DARPA Electronics Resurgence Initiative: <https://www.darpa.mil/work-with-us/electronics-resurgence-initiative>

¹¹ Prize Challenges," Defense Advanced Research Projects Agency, <https://www.darpa.mil/work-with-us/public/prizes>; "AI to Solve the World's Grand Challenges," XPRIZE Foundation, <https://www.xprize.org>